

			12. Operational characteristics of single-phase rectifiers without a filter 13. Operational characteristics of single-phase rectifiers with a filter 14. Characteristics of three-phase networks and transformers (star/delta connection) 15. Characteristics of three-phase networks and transformers (star/star connection) 16. Operational characteristics of single-phase controlled rectifiers with active load 17. Operational characteristics of three-phase controlled rectifiers with active load		
24	2	set	<b>Desktop Computer, all in one model</b>  Desktop Computer, all-in-one, 21.5 " LED monitor(or higher), CPU: i3; RAM: 4G; HDD: 1T; DVD RW; OS: Windows 8; mouse & keyboard; with UPS	P	P
25	1	lot	<b>(Laboratory Tables, Teacher &amp; Student Chairs, Hanging storage Cabinet, Interactive Whiteboard &amp; Multimedia projector)</b>  <b>Laboratory Table (4 pcs)</b> 2440 x 800mm, 30mm laminated board table top, with PVC edging. 18mm laminated board with PVC edging, electrical outlets with removable front plate. Includes wiring provisions for four 2-gang universal outlet. Powder-coated Tubular steel metal framing. Detachable with joining pins. <b>Teacher's table (1)</b> 1000x950x780mm Table 18mm Laminated Board with PVC edging <b>Teacher's chair (1)</b> Executive type Non Folded Finished Materials: PU + Steel + PP Back: PU or better Seat: Cutting sponge with PU or better ; Armrest: steel, powder coated or of similar Foam: High Density Foam or better	P	P
			<b>Laboratory Bench Stools (40 pcs)</b> 12" round wooden seat, at least 1" thick Tubular 4-legged base Steel tubing heavy duty frame 18" Seat Height Powder-coated frame Color: preferably Navy blue/ dark blue <b>Storage Cabinet (2pcs)</b> 1.20m x 1.90m Sliding Glass doors on powdercoated aluminum frame with lock 18mm laminated boards with PVC edging <b>Interactive Whiteboard (1)</b>		

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			78" diagonal surface, 4 pens, 1wand, wall-mount, USB Interface computer connection, Workspace software; Infrared Technology-pen & finger touch with Windows, Mac or Linux; Multi-touch with Windows 7; aspect ratio; 4:3; 8000x8000 resolution; Android & IOS tablet compatible.		
			<b>Multimedia Projector (1)</b>  USB 3LCD Projector, 2800 ( or better)Lumens White and Colour Light Output , Computer Cable, USB A/USB B Cables, Remote Control, Soft Carry Case & Manual		

### 3. Communications and Digital Laboratory

26	4	set	Educational Laboratory Virtual Instrumentation Suite	P	P
			<p>Platform Features:</p> <ul style="list-style-type: none"> <li>• Open architecture for third-party plug-in boards</li> <li>• Hi-Speed USB plug-and-play connectivity</li> <li>• 1.25 MS/s oscilloscope</li> <li>• 51/2-digit isolated digital multimeter</li> <li>• ±15 and +5 V power supply</li> <li>• Manual control – function generator and variable power supply</li> <li>• Circuit protection with resettable fuse.</li> </ul> <p>Integrated Suite of 12 Virtual Instruments</p> <ul style="list-style-type: none"> <li>• Oscilloscope</li> <li>• Function generator (manual control)</li> <li>• Digital Multimeter (DMM)</li> <li>• Arbitrary waveform generator</li> <li>• Bode analyzer</li> <li>• 2-wire current voltage analyzer</li> <li>• 3-wire current voltage analyzer</li> <li>• Dynamic signal analyzer (DSA)</li> </ul>		
			<ul style="list-style-type: none"> <li>• Impedance analyzer</li> <li>• Digital reader</li> <li>• Digital writer</li> <li>• Variable power supply (manual control)</li> </ul>		
			<p>Driver Software (included)</p> <ul style="list-style-type: none"> <li>• NI-ELVISmx</li> <li>• LabVIEW SignalExpress</li> </ul>		
27	8	unit	Fiber Optics Communication Board	P	P
			<p>Compatible with ELVIS platform</p> <p>Specifications:</p> <ul style="list-style-type: none"> <li>- 20 patching leads</li> <li>- 7 optical fibers</li> <li>- headphones</li> <li>- user and experimenter manuals</li> <li>- BNC copes leads</li> <li>- easy to use and highly student resistant</li> <li>- allows the student to do over 12 experiments in digital and fiber optic communications in the one,</li> <li>- self contained portable unit</li> <li>- only requires the additional use of a PC</li> <li>- topics covered in Experiment Manual</li> <li>- introduction to the experimental module</li> <li>- PCM encoding</li> <li>- PCM decoding</li> <li>- Sampling and Nyquist in PCM</li> <li>- Time Division multiplexing (TDM)</li> <li>- Line coding and bit-clock regeneration</li> <li>- Fiber optic transmission</li> </ul>		

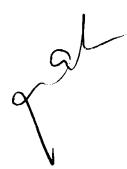
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			<ul style="list-style-type: none"> <li>- PCM-TDM 'T1' implementation</li> <li>- Optical digital filtering, splitting and combining</li> <li>- Fiber optic bi-directional communication</li> <li>- Wave division multiplexing (WDM)</li> <li>- Optical losses</li> </ul>		
28	8	unit	<b>Signal Processing Experimenter</b>  Compatible with ELVIS platform Includes: <ul style="list-style-type: none"> <li>- 16 experiment Lab Manual covers</li> <li>- easily be integrated or adapted to suit your current signals and systems</li> </ul> Lab 1: Introduction to the SIGEx board Lab 2: Special signals – characteristics and applications Lab 3: Systems: Linear and non-linear Lab 4: Unraveling convolution Lab 5: Integration, convolution, correlation & matched Lab 6: Exploring complex numbers and exponentials Lab 7: Build a Fourier series analyzer Lab 8: Spectrum analysis of various signals Lab 9: Time domain analysis of RC networks Lab 10: Poles and zeros in Laplace domain Lab 11: Sampling and Aliasing Lab 12: Getting started with analog-to-digital conversion Lab 13: Discrete-time filters – FIR Lab 14: Poles and zeros in the z-plane: IIR forms  Lab 15: Discrete-time filters – practical applications App A: SIGEx Lab to Textbook chapter table SIGEx	P	P
29	8	unit	<b>Telecommunication Board</b>  Compatible with ELVIS platform - Board accessories kit includes: <ul style="list-style-type: none"> <li>- 20 x stackable patch cords</li> <li>- User Manual</li> </ul>  - Digital and Analog Basic Telecommunications Experiments Manual Volume-1 - DATEX SFP CD-ROM Telecommunication Topics: Basic Analog Communications AM, FM, DSB, SSB, PM, PAM, TDM, PWM, Superheterodyne, Speech in Comms, PLL, QAM, SNR Concepts and more  Digital Communications PCM, PCM-TDM, ASK, BPSK, FSK, GFSK, Eye Patterns, DPSK, QPSK, Spread Spectrum, Line Coding, Noise Generation, SNR Concepts and more.	P	P
30	8	unit	<b>Digital Trainer</b>  Components: -standard PB-501 breadboard -8 Data Switches - The data switch circuits provides eight DATA OUTPUT pins D1 to D8 whose output level is adjusted using slide  • 8 Data Status Monitor - Has eight buffered inputs with LED indicators that show the current state of the inputs.  • 555-Based Clock Generator - The circuit is based on a 555 IC configured as an astable multivibrator. The signal is accessible through the OUT pin. An overlapping LOW (10 Hz to 500 Hz) and control as well as VR1 for fine tuning control.  • Pulse Generator - A monostable signal generator based on the 74HC221 IC. These are two outputs, pressing a switch generates a pulse across the corresponding output pin.	P	P

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			<ul style="list-style-type: none"> <li>Logic Probe - The probe displays the status of the signal fed across its input pins using three LED status indicators, one each for HIGH, LOW and PULSE.</li> <li>5-Volt Power Supply - This supply is the same power source used for the rest of the modules such that the user need not worry about compatibility problems when using the built-in modules in the trainer.</li> </ul>		
31	8	unit	<b>Transmission Line Trainer</b>	P	P
			<p>All elements are mounted in a metallic box, with power supply and block diagrams.</p> <ul style="list-style-type: none"> <li>Generator blocks:           <ul style="list-style-type: none"> <li>Square signal generator.</li> <li>Sine signal generator.</li> <li>Triangle signal generator.</li> </ul> </li> <li>Each generator block has a Radio-Frequency Tuning and four BNC connectors with different line impedances (<math>25\Omega</math>, <math>50\Omega</math>, <math>75\Omega</math> and <math>100\Omega</math>).</li> <li>Transmission line block:</li> </ul> <p>Two transmission lines made of 40 m. length coaxial cable (total length joining the two transmission lines is 80 m.).            Different test points along the lines (each 10 m.).</p> <ul style="list-style-type: none"> <li>Load block:           <ul style="list-style-type: none"> <li>Fully configurable termination load, through switches on each load branch.</li> <li>Short circuit termination.</li> <li>Capacitive load.</li> <li>Resistive load (fixed electric resistances and potentiometers).</li> <li>Inductive load.</li> </ul> </li> </ul> <p>Cables and Accessories, for normal operation.</p>		
			<ul style="list-style-type: none"> <li>Manuals:           <ul style="list-style-type: none"> <li>Required Services</li> <li>Assembly and Installation</li> <li>Starting-up</li> <li>Safety, Maintenance &amp; Practices Manuals.</li> </ul> </li> <li>Dimensions:           <ul style="list-style-type: none"> <li>490 x 330 x 310 mm. approx. (19.29 x 12.99 x 12.20 inches approx.)</li> </ul> </li> <li>Weight:           <ul style="list-style-type: none"> <li>20 Kg. approx. (44 pounds approx.).</li> </ul> </li> </ul>		
32	3	unit	<b>Antenna Trainer</b>	P	P
			<p>Includes:</p> <ul style="list-style-type: none"> <li>Control Interface Box:           <ul style="list-style-type: none"> <li>- Radio-Frequency generator</li> <li>- Spectrum analyzer</li> <li>- Stepper motor controller</li> </ul> </li> <li>Low power for safety operation (under 10dBm transmission power).</li> <li>Radio-Frequency tuning, computer controlled.</li> <li>Frequency control and measurement from the computer (PC).           <ul style="list-style-type: none"> <li>Wide range of frequencies in UHF band.</li> <li>BNC connector to transmitter antenna.</li> <li>Operate in UHF band.</li> <li>BNC connector to receptor antenna.</li> <li>SWR- meter (included in the Control Interface Box):               <ul style="list-style-type: none"> <li>Measurement of SWR from the computer (PC).</li> </ul> </li> </ul> </li> </ul>		

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			<ul style="list-style-type: none"> <li>• BNC connector to transmitter antenna.</li> <li>• BNC connector to radio-frequency generator.</li> <li>• Two towers antennas:</li> <li>• Tower for the receptor antenna.</li> <li>• Tower for the transmitter antenna.</li> <li>• Stepper motor coordinate with an encoder, all of these components are computer controlled.</li> </ul> <p>• allows the full-automatic 360° rotation of the transmitter antenna</p> <ul style="list-style-type: none"> <li>• EANC-1. Antennas Kit:</li> <li>• High sensibility Log-periodic antenna for the receptor.</li> </ul>		
			<ul style="list-style-type: none"> <li>• Monopole antenna with Ground plane.</li> <li>• Drooping monopole antenna.</li> <li>• Straight dipole antennas (<math>\lambda/2</math> and <math>\lambda</math>).</li> <li>• Folded dipole antenna (<math>\lambda/2</math>).</li> <li>• Helical antenna (right-hand circular polarization).</li> <li>• Helical antenna (left-hand circular polarization).</li> <li>• Circular loop antenna.</li> <li>• Square loop antenna.</li> <li>• Diamond loop antenna.</li> <li>• Microstrip patch antenna.</li> <li>• Yagi-Uda antenna.</li> <li>• Antenna expositor</li> <li>• RF transformer</li> <li>• Space required between antennas: 2-3 m.</li> </ul> <p>Complete unit includes as well:</p> <ul style="list-style-type: none"> <li>• Advanced Real-Time SCADA.</li> <li>• Open Control + Multicontrol + Real-Time Control.</li> <li>• Specialized Control Software based on Labview.</li> <li>• National Instruments Data Acquisition board (250 KS/s , kilo samples per second).</li> </ul>		
			<ul style="list-style-type: none"> <li>• Projector and/or electronic whiteboard compatibility</li> </ul>		
33	4	unit	Microwave Trainer	P	P
			<p>Specifications:</p> <ul style="list-style-type: none"> <li>• Microwaves signal generator:</li> <li>◦ Solid state dielectric resonance oscillator (DRO).</li> <li>◦ Radio-Frequency tuning.</li> <li>◦ X-band range of frequencies from 8.8GHz to 12GHz.</li> <li>• Power meter.</li> <li>• SWR meter.</li> <li>• Crystal probe.</li> <li>• Thermistor probe.</li> <li>• Slotted line waveguide.</li> <li>• Slide-Screw Tuner.</li> <li>• Crossguide waveguide.</li> <li>• Directional coupler.</li> <li>• MagicorHybrid Tee.</li> <li>• Variable attenuators waveguides.</li> <li>• Fixed attenuators waveguides.</li> <li>• Short circuit terminations.</li> <li>• Adjustable termination.</li> <li>• Dummy loads.</li> <li>• Two towers antennas, one of them with azimuth indicator.</li> <li>• Horn Antennas.</li> <li>• All the waveguide have the standard size WR90.</li> <li>• Cables and accessories, for normal operation.</li> </ul>		

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			Exercise and practical possibilities: 1. Familiarization with a microwaves test bench. 2. Power emissions measurement. 3. Study of different Attenuation measurement.		
			4. Wavelength and frequency measurement through a probe mounted on a slotted line waveguide. 5. Wavelength and frequency measurement through a frequency meter. 6. Stationary wave (SWR) measurements. 7. Basic principles of Smith chart. 8. Impedance and admittance. 9. Complex impedance, reflection coefficient. 10. Stationary wave diagram for different loads. 11. Comparison of matched and mismatched loads. 12. Study of the Tees and crossguide. 13. Measure of wavelength in free space. 14. Measure of power emission in free space. 15. Study of gain and directivity of a horn antenna (dBi). 16. Radiation pattern of a horn antenna. 17. Reflection of a dielectric plate and metallic plate.  Dimensions&Weight • Dimensions: 700x700x1100mm. approx. • Weight: 25 Kg. approx. Required Services • Electrical supply: single-phase, 220V./50Hz		
34	8	unit	Milliammeter	P	P
			• Bright large screen VFD display • Digital display : 4 1/2 digits • Frequency range 5 Hz to 5 MHz • AC voltage 50 $\mu$ V to 300 V • ACV test resolution is up to 0.1 $\mu$ V • Two independent input channels • Auto or manual ranging can be selected • Standard accessory interface is RS-232		
35	8	unit	Digital Multitesters	P	P
			• 3 1/2 LCD display with maximum reading of 1999 • Overload protection • Auto power off function • Data hold function • Capacitance measurements • Shock Case • Mechanical protection • 2000uF test function • Diode Testing : YES • Audio Testing : YES • Continuity Buzzer : YES • Auto power Off : YES • Data hold : YES • Low battery indication: YES Technical Specification: • Voltage DC : 200mV/2V/20V/200V/1000V • Voltage AC: 200mV/2V/20V/200V/700V • Direct Current: 2mA/20 mA/200 mA/10A • Alternating Current: 2mA/20 mA/200 mA/10A • Resistance: 200 $\Omega$ /2k $\Omega$ /20k $\Omega$ /200k $\Omega$ /2M $\Omega$ /200M $\Omega$		
36	1	lot	(Laboratory Tables, Interactive Whiteboard, Storage Cabinets & Multimedia Devices) 1 Lot	P	P
			LABORATORY TABLE (8pcs)		

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			<p>2440 x 800mm, 30mm laminated board table top with PVC edging, provided with grommet caps for computer monitor wire access.</p> <p>Powder-coated steel casing for table top electrical outlets with removable front plate, powder-coat finish. Includes wiring provisions for eight 2 gang universal outlet and LAN provision for two (2) computers.</p> <p>Plastic keyboard tray</p> <p>Powder-coated Tubular metal framing with perforated plate cover for table legs support and adjustable metal glides.</p> <p>18mm laminated board with PVC Edgeband CPU shelving</p> <p><b>MULTIMEDIA PROJECTOR (1)</b> USB 3LCD Projector, 2800 ( or better)Lumens White and Colour Light Output , Computer Cable, USB A/USB B Cables, Remote Control, Soft Carry Case &amp; Manual</p> <p><b>INTERACTIVE WHITEBOARD (1)</b> 78" diagonal surface, 4 pens, 1wand, wall-mount, USB Interface computer connection, Workspace software; Infrared Technology-pen &amp; finger touch with Windows, Mac or Linux; Multi-touch with Windows 7; aspect ratio; 4:3; 8000x8000 resolution; Android &amp; IOS tablet compatible.</p> <p><b>STORAGE CABINET (1)</b> 1.20m x 1.90m Sliding Glass doors on powder-coated aluminum frame with lock</p>		
18mm laminated boards with PVC edging					

#### 3.3 Electrical Machines, Installation and Motor Controls

37	8	unit	Analog Multimeter	P	P
			<ul style="list-style-type: none"> <li>Easy to assemble</li> <li>Break-proof body cover</li> <li>Soldered test leads providing better safety</li> <li>Portable analog multimeter</li> </ul> <p>Technical Specification:</p> <ul style="list-style-type: none"> <li>• DCV: 0.3/3/12/30/120/300/600V (20kΩ/V)</li> <li>• ACV: 12/30/120/300/600V (9kΩ/V)</li> <li>• DCA: 60µ/3m/30m/0.3A</li> <li>• Resistance: 20/200/20kΩ</li> <li>• Battery check: 1.5</li> <li>• Bandwidth: 50 or 60Hz (sine wave)</li> <li>• Battery: UM-3(1.5V) x 2</li> <li>• Fuse: Ø5.2x20mm (250V/0.5A)</li> <li>• Size/Mass: H159.5 x W129 x D41.5mm/.320g</li> <li>• Standard Accessories included: Instruction Manual</li> </ul>		
38	8	unit	Digital Multimeter	P	P
			<ul style="list-style-type: none"> <li>• 3 1/2 LCD display with maximum reading of 1999</li> <li>• Overload protection</li> </ul> <ul style="list-style-type: none"> <li>• Auto power off function</li> <li>• Data hold function</li> <li>• Capacitance measurements</li> <li>• Shock Case</li> <li>• Mechanical protection</li> <li>• 2000µF test function</li> <li>• Diode Testing : YES</li> <li>• Audio Testing : YES</li> </ul>		

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			<ul style="list-style-type: none"> <li>• Continuity Buzzer : YES</li> <li>• Auto power Off : YES</li> <li>• Data hold : YES</li> <li>• Low battery indication: YES</li> </ul> <p>Technical Specification:</p> <ul style="list-style-type: none"> <li>• Voltage DC : 200mV/2V/20V/200V/1000V</li> <li>• Voltage AC: 200mV/2V/20V/200V/700V</li> <li>• Direct Current: 2mA/20 mA/200 mA/10A</li> <li>• Alternating Current: 2mA/20 mA/200 mA/10A</li> <li>• Resistance: 200Ω/2kΩ/20kΩ/200kΩ/2MΩ/20MΩ/200MΩ</li> </ul>		
39	1	set	<b>Integrated Laboratory for Electrical Machines</b> A. Consisting of the following: <b>1. Electrical Machines Unit (Power Supply)</b> <ul style="list-style-type: none"> <li>- Metallic box.</li> <li>- Diagram in the front panel.</li> <li>- Thermal Magnetic Circuit Breaker.</li> <li>- Two double switches (1 NO + 1 NC in each one)</li> <li>- Push Button (1 NC + 1 NO).</li> <li>- Three contactors with 2 NO and 1 NC.</li> </ul> <ul style="list-style-type: none"> <li>- DC supply 200 V dc with fuses.</li> <li>- Connection Key</li> <li>- Emergency stop Push button.</li> </ul> <b>2. Electric Power Data Acquisition System</b> <p>A.1)Hardware :</p> <p>A.1.1.) EPIB. Electric power interface box ( dimensions: 300 x 120 x 180 mm. approx.): Interface that carries out the conditioning of the diverse signals that can be acquired in a process, for their later treatment and visualisation.</p> <p>Front panel separated in two: left-hand part for VOLTAGE sensors, and right-hand part for CURRENT sensors.</p> <ul style="list-style-type: none"> <li>- 8 analog input channels. - Sampling range: 250 KSPS (Kilo samples per second).</li> <li>- 4 Tension sensors AC/DC, 400V. - 4 Current sensors.</li> </ul> <p>A.1.1.2) DAB. Data acquisition board : PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.</p> <p>Analog input:</p> <ul style="list-style-type: none"> <li>- Number of channels= 16 single-ended or 8 differential.</li> <li>- Resolution=16 bits, 1 in 65536.</li> <li>- Sampling rate up to: 250 KSPS (Kilo samples per second).</li> <li>- Input range (V)=± 10V.</li> <li>- Data transfers=DMA, interrupts, programmed I/O.</li> <li>Number of DMA channels=6.</li> </ul> <p>Analog output:</p> <ul style="list-style-type: none"> <li>- Number of channels=2. Resolution=16 bits, 1 in 65536.</li> <li>- Maximum output rate up to: 833 KSPS.</li> <li>- Output range(V)=± 10.</li> <li>- Data transfers=DMA, interrupts, programmed I/O</li> </ul> <p>Digital Input/Output:</p> <ul style="list-style-type: none"> <li>- Number of channels=24 inputs/outputs.</li> <li>- D0 or DI Sample Clock frequency: 0 to 1 MHz.</li> <li>- Timing: Counter/timers=2. Resolution: Counter/timers: 32 bits.</li> </ul> <p>A.2) Data Acquisition Software :</p> <ul style="list-style-type: none"> <li>- Data Acquisition Software with Graphic Representation: Amicable graphical frame.</li> <li>- Compatible with actual Windows operating systems.</li> </ul>	P	P

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		<ul style="list-style-type: none"> <li>- Configurable Software allowing the Representation of temporal evolution of different signals.</li> <li>Visualization of Circuit tensions on the computer screen.</li> <li>- Sampling rate up to 250 KS/s (Kilo samples per second) guaranteed.</li> </ul> <p><b>3. Three Phase transformer</b></p> <ul style="list-style-type: none"> <li>- Input and output connectors.</li> <li>- Three phase transformer, 400 V a.c - 230 V a.c.,</li> <li>- input and output connectors.</li> </ul> <p><b>4. Single phase transformer, 400 V a.c. - 230 V a.c., 400 VA.</b></p> <ul style="list-style-type: none"> <li>- Ground connector.</li> </ul> <p><b>5. Variable autotransformer</b></p> <ul style="list-style-type: none"> <li>- input and output connectors.</li> <li>- Three phase transformer, 400 V a.c - 230 V a.c.,</li> <li>- input and output connectors.</li> </ul> <p><b>6. Resistive, Inductive and Capacitance Load Module</b></p> <ul style="list-style-type: none"> <li>- Metallic box.</li> </ul>	
		<ul style="list-style-type: none"> <li>- Diagram in the front panel.</li> <li>- Variable resistive loads: <math>3 \times [150(500 \text{ W})]</math></li> <li>- Fixed resistive loads:</li> <li><math>3 \times [150(500 \text{ W}) + 150 (500 \text{ W})]</math>.</li> <li>- Inductive loads:</li> <li><math>3 \times [0, 33, 78, 140, 193, 236 \text{ mH}] \cdot (230V / 2A)</math></li> <li>- Capacitive loads:</li> <li><math>3 \times [4 \times 7 \mu\text{F}] \cdot (400V)</math></li> </ul> <p><b>7. DC Series Excitation Motor Generator</b></p> <ul style="list-style-type: none"> <li>Power: 250-300W.</li> <li>Speed: 3000 r.p.m.</li> <li>V.excitation: 220 V.D.C.</li> <li>I.Excitation nominal: 0.3A.</li> <li>V.Armature.: 200V D.C.</li> <li>I.Armature nominal: 1.5A.</li> </ul> <p><b>8. DC Shunt Excitation Motor generator</b></p> <ul style="list-style-type: none"> <li>Power: 250-300W.</li> <li>Speed: 3000 r.p.m.</li> <li>V.excitation: 190 V.D.C.</li> <li>I.Excitation nominal: 0.3A.</li> <li>V.Armature.: 200V D.C.</li> <li>I.Armature nominal: 1.5A.</li> </ul> <p><b>9. AC Synchronous Alternator Motor</b></p> <ul style="list-style-type: none"> <li>Power: 250-300W.</li> <li>Speed: 3000 r.p.m.</li> <li>Frequency: 50Hz.</li> <li>Connections: Star/triangle.</li> <li>V.excitation nominal: 220V D.C.</li> <li>I.Excitation nominal: 0.59A.</li> <li>V.Armature.: 3x220/380V.</li> </ul>	
		<p><b>10. Three Phase Asynchronous Motor Squirrel Cage (750rpm,8poles,550w)</b></p> <ul style="list-style-type: none"> <li>Power: 250-300W.</li> <li>Speed: 2769 r.p.m. (50Hz), 3330 r.p.m. (60Hz).</li> <li>Connections: Star/triangle.</li> <li>Frequency: 50/60 Hz.</li> <li>V.Armature: 230/400V (50Hz), 250/440V. (60Hz).</li> <li>I.Armature nominal: 1A-0.7A.</li> </ul> <p><b>11. Three Phase Reluctance Motor</b></p> <ul style="list-style-type: none"> <li>Three-phase. 380 V.</li> <li>Power: 200W.</li> <li>Speed: 3000 r.p.m.</li> <li>Frequency: 50 Hz.</li> </ul> <p><b>12. Three Phase Asynchronous Motor with wound Rotor</b></p> <ul style="list-style-type: none"> <li>Power: 300W.</li> </ul>	

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			<p>Speed: 1413 r.p.m. Frequency: 50Hz. V.Armature.: 230/400V. I.Armature nominal: 1A-0.7A.</p> <p><b>13. Single Phase Asynchronous Motor with Starting Capacitor</b> Power: 370W. Speed: 2800 r.p.m. Frequency: 50Hz. V.Armature.: 230V. I.Armature nominal: 1.5A.</p> <p><b>14. Single Phase Universal Motor</b> Power: 4-8W. Speed: 480/14000 r.p.m. Frequency: 50Hz. V.Armature.: 230/240V. Power: 250W. Speed: 2800 r.p.m. Frequency: 50 Hz. V.Armature: 230V.</p> <p><b>15. Single Phase Asynchronous Motor with Starting and</b> Power: 370W. Speed: 2800 r.p.m. Frequency: 50Hz. V.Armature.: 230V. I.Armature nominal: 1.5A.</p> <p><b>16. DC Motor Speed Controller</b> - Metallic box. - Regulated voltage output up to 320 Vdc. Maximum current output 2 A. - Front panel including: Connections: - Positive, negative and Ground connections. on/OFF switch. - The top side of the unit include a wheel to adjust</p>		
40	1	assy	<p><b>17. AC Motor Speed Controller</b> - Metallic box. - Output: 3 PH, 3.0 KVA, 220 V, 1-50 Hz., 8.0 A. - Overload current Thermal protection. - on/OFF switch. - It has two blocks in the front panel: - Speed control: - Start/stop switch. - Speed control potenciometer. - Connections to motor: - Three-phase Connection to AC motor. - Ground connection.</p> <p><b>B.Personal Computers (2 units)</b> Desktop Computer, all-in-one, 21.5 " LED monitor(or</p>	P	P

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			<p>armature field and interpole coils</p> <p>compound field coils</p> <p>field coils</p> <p>centrifugal switch</p> <p>robust case for the elements</p> <p>necessary tools and elements for normal working operation</p> <p>all machines that may be assembled using low voltage,</p> <ul style="list-style-type: none"> <li>- Panel for connections and protections:</li> <li>- Anodized aluminium structure with Panel in painted steel.</li> <li>- Diagrams for each practice, which explains the different connection configurations.</li> <li>- Connections box, that allows to make different connections for each practice.</li> <li>- Protection circuit that is used to protect each module short circuits.</li> <li>- Drive motor: Asynchronous Three-phase motor of Power: 370W.</li> <li>Speed: 2730 r.p.m.</li> <li>Frequency: 50/60 Hz.</li> <li>V.Armature: 230/400V.</li> <li>I.Armature nominal: 1.67/0.97A.</li> <li>Connections: Star/triangle.</li> <li>- AC motor speed controller.</li> <li>Metallic box.</li> </ul>		
			<p>Power: 3kVA.</p> <p>Frequency: 1-50 Hz.</p> <p>Phase voltage: 230 Vac.</p> <p>Maximum current: 8A.</p> <p>Overshoot thermal protection.</p> <p>ON/OFF switch.</p> <p>It has two blocks in the front panel:</p> <p>Speed control: Start/Stop switch and speed control</p> <p>Connections to motor:</p> <p>Three-phase connection to AC motor and ground</p> <ul style="list-style-type: none"> <li>- DC motor speed Controller</li> </ul> <p>Metallic box.</p> <p>Adjustable voltage: up to 320 Vdc.</p> <p>Maximum current: 2 A.</p> <p>At the top of the unit there is a knob to adjust the DC voltage.</p> <p>Front panel including: Positive, negative and ground</p> <ul style="list-style-type: none"> <li>- <b>Velocity Control for stepper motor:</b></li> </ul> <p>This unit is used for controlling the stepper motor</p> <p>Metallic box.</p> <p>Cables and accessories, for normal operation.</p>		
41	2	set	<p><b>Integrated Electrical Installation Laboratory</b></p> <p>a. Modular Trainer (AC Motors)</p> <p>b. Modular Trainer for Electronics (Complete Option)</p> <p>c. Star Delta Starter</p>	P	P
			<p>a. Modular Trainer (AC Motors)</p> <p>Industrial Main Power Supply</p> <ul style="list-style-type: none"> <li>- Magneto-thermal protection.</li> <li>- Differential protection.</li> <li>- Double plug and terminals (three)</li> </ul>		
			<ul style="list-style-type: none"> <li>- 2 lamps.</li> <li>- 8 terminals.</li> <li>- Mushroom security button.</li> <li>- Removable key.</li> </ul> <p>AC Auxiliary Power Supply (24Vac)</p>		

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			<ul style="list-style-type: none"> <li>- 230 / 24 Vac transformer.</li> <li>- 4 terminals.</li> </ul> <p>3 Double Chamber</p> <p>Push-buttons. (2 units)</p> <ul style="list-style-type: none"> <li>- 3 double chamber push buttons (one closed and one open)</li> <li>- for actions of start/stop of motors.</li> </ul> <p>3-pole Contactor (24Vac) (4 units)</p> <ul style="list-style-type: none"> <li>- 3 pole contactor, 9 A.</li> <li>- Control coil 24 Vac.</li> <li>- Auxiliary contacts 3NO + 2NC.</li> </ul> <p>Frequency variator</p> <ul style="list-style-type: none"> <li>- Frequency, voltage and current control and programming.</li> <li>- motor specification required for programming.</li> </ul> <p>Thermal relay (GV protector) module (2 units)</p>		
			<ul style="list-style-type: none"> <li>- Three-phase of 10A.</li> </ul> <p>Synchronization Relay (variable delay)</p> <ul style="list-style-type: none"> <li>- 2 regulation relays.</li> <li>- Work and rest activation time control.</li> <li>- Digital display.</li> <li>- Adjustable delay.</li> </ul> <p>Motor (squirrel cage)</p> <ul style="list-style-type: none"> <li>-squirrel cage.</li> <li>-Three phase Asynchronous motor.</li> <li>-270 W.</li> <li>-3000 rpm.</li> </ul> <p>Motor (Dahlander motor)</p> <ul style="list-style-type: none"> <li>-2 speeds.</li> <li>-Three phase Asynchronous motor.</li> <li>-250 W.</li> <li>-2800/1400 rpm.</li> </ul> <p><b>b. Modular Trainer for Electronics</b></p> <ul style="list-style-type: none"> <li>- AC and DC Power supply module that allows the following output voltages:</li> </ul> <p>Alternating:</p> <ul style="list-style-type: none"> <li>15 + 25 V, 0.5 A</li> <li>24 V, 2 A</li> </ul> <p>Direct:</p> <ul style="list-style-type: none"> <li>24 V, 2 A</li> <li>0-20 V, 2 A</li> </ul> <p>Inductances Module</p> <ul style="list-style-type: none"> <li>- 9 inductances from 1 mH to 45 mH for assemblies R, L, C components</li> </ul> <p>Capacitors Module</p> <ul style="list-style-type: none"> <li>- 7 independent not polarised ones, from 56 nF 470</li> </ul>		
			<ul style="list-style-type: none"> <li>- 2 polarised of 220 mF and 470 mF V.</li> </ul> <p>Rectifier Diodes Module</p> <ul style="list-style-type: none"> <li>- Rectifier diodes of 40 A (6 units).</li> <li>- Some assemblies:</li> </ul> <p>Positive/negative simple rectification.</p> <p>Single-phase and three-phase bridge rectification.</p> <p>Double rectification.</p> <p>Filtrate of voltage of the assemblies can be made</p> <p>Resistive Components Module</p> <ul style="list-style-type: none"> <li>- Fixed resistances, with values from 47 to 159 K ohms. (14 units).</li> <li>- Linear potentiometers , one of them coiled of 5 W.</li> <li>- Logarithmic potentiometers.(2 units).</li> </ul>		

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			<p>Three Phase Transformer</p> <ul style="list-style-type: none"> <li>- Transformer of three branches:</li> <li>Primary ones: 220 and 380 V.</li> <li>Secondary ones: 3x73 V by branch.</li> <li>Power: 500 W.</li> <li>- Possible practices:</li> <li>The transformer as a booster (single-phase).</li> <li>The transformer as a reducer Autotransformer</li> <li>Star connection (three-phase).</li> <li>Delta connection</li> <li>Transformers in series and in parallel (single-phase).</li> </ul>		
			<p>Electromagnetism Kits with group of motor/generator</p> <ul style="list-style-type: none"> <li>- It is based on A printed circuit with the</li> <li>- Set of two coils.</li> <li>- Longitudinal magnet.</li> <li>- Group motor/generator with its axis united</li> </ul> <p>Dismantled transformer kit</p> <ul style="list-style-type: none"> <li>- A nucleus in "U".</li> <li>- A coil with 1000 turns.</li> <li>- A coil with 2000 turns.</li> <li>- Nucleus close in "I".</li> <li>- Case.</li> </ul> <p>Electrostatic kit</p> <ul style="list-style-type: none"> <li>- Ebinita bar.</li> <li>- Plexiglas bar.</li> <li>- Vertical base and hook.</li> <li>- Balls.</li> <li>- Cat skin.</li> <li>- Case for the components storage.</li> <li>- Acetate sheets.</li> <li>- aluminium sheets.</li> <li>- Electrometer</li> </ul> <p>Open Universal Motor</p> <ul style="list-style-type: none"> <li>- Universal motor open by its sides to see inside,</li> </ul> <p>c. Star-Delta Starter</p> <p>Industrial Main Power Supply</p> <ul style="list-style-type: none"> <li>- Magneto-thermal protection.</li> <li>- Differential protection.</li> <li>- Double plug and terminals (three</li> <li>- 2 lamps.</li> <li>- 8 terminals.</li> <li>- Mushroom security button.</li> <li>- Removable key.</li> </ul>		
			<p>Push-Buttons with Light (24Vac)</p> <ul style="list-style-type: none"> <li>-3 push buttons with light.</li> <li>-24 Vac.-NO and NC contacts.</li> </ul> <p>3-pole Contactor (24Vac (3 units)</p> <ul style="list-style-type: none"> <li>- 3 pole contactor, 9 A.</li> <li>- Control coil 24 Vac.</li> <li>- Auxiliary contacts 3NO + 2NC.</li> </ul>		
42	1	set	Electric motors with speed control and loads	P	P
			<p>1. Electrical Machines Unit ( Basic)</p> <ul style="list-style-type: none"> <li>Metallic box.</li> <li>Diagram in the front panel.</li> <li>Thermal Magnetic Circuit Breaker.</li> <li>DC supply 200 V dc with fuses.</li> <li>Connection Key.</li> <li>Emergency stop push button.</li> <li>Two push buttons (1NO + 1NC).</li> </ul> <p>2. Network Analyzer</p> <ul style="list-style-type: none"> <li>Metallic box.</li> <li>Diagram in the front panel.</li> </ul>		

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CET Re-Bid

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			<p>3 current inputs, for series intensity.      3 voltage terminals, for each phase measure      Control and visualization digital display.      Voltage: Range 20 - 500 Vrms. Prec.: 0.5%.</p>		
			<p>Current: Range 0.02 - 5 Arms. Prec.: 0.5%.      Frequency: Range 48 to 62 Hz. 0.1Hz.      Power: Active, Reactive and Apparent. Range 0.01 to 9900 kW. Prec.: 1%.      Power Factor: Power Factor for each phase and average. Range -0.1 to + 0.1. Prec.: 1%.      Operating temperature 0 to +50°C.</p> <p><b>3. Resistive, Inductive and Capacitance Load Module</b>      - Metallic box.      - Diagram in the front panel.      - Variable resistive loads: 3 x [ 150(500 W) ]      - Fixed resistive loads:      3 x [ 150(500 W) + 150 (500 W) ].      - Inductive loads:      3 x [ 0, 33, 78, 140, 193, 236 mH ].(230V / 2 A)      - Capacitive loads:      3 x [ 4 x 7 µF ]. (400V)</p> <p><b>4. DC Shunt- Series Compound Excitation Motor</b>      Power: 250-300W.      Speed: 3000 r.p.m.      V.excitation: 220 V.D.C.      I.Excitation nominal: 0.3A.      V.Armature.: 200V D.C.      I.Armature nominal: 1.5A.</p> <p><b>5. AC Synchronous Alternator Motor</b>      Power: 250-300W.      Speed: 3000 r.p.m.      Frequency: 50Hz.      Connections: Star/triangle.      V.excitation nominal: 220V D.C.</p>		
			<p>I.Excitation nominal: 0.59A.      V.Armature.: 3x220/380V.</p> <p><b>6. Three Phase Asynchronous Motor Squirrel</b>      Power: 250-300W.      Speed: 2769 r.p.m. (50Hz), 3330 r.p.m. (60Hz).      Connections: Star/triangle.      Frequency: 50/60 Hz.      V.Armature:230/400V (50Hz), 250/440V.      I.Armature nominal: 1A-0.7A.</p> <p><b>7. Three Phase Asynchronous Motor with wound</b>      Power: 300W.      Speed: 1413 r.p.m.      Frequency: 50Hz.      V.Armature.: 230/400V.      I.Armature nominal: 1A-0.7A.</p> <p><b>8. Single Phase Asynchronous Motor with Starting Capacitor</b>      Power: 370W.      Speed: 2800 r.p.m.      Frequency: 50Hz.      V.Armature.: 230V.      I.Armature nominal: 1.5A.</p> <p><b>9. Single Phase Universal Motor</b>      Power: 4-8W.      Speed: 480/14000 r.p.m.      Frequency: 50Hz.</p> <p><b>10. Single Phase Asynchronous Motor with</b></p>		
			<p>V.Armature.: 230/240V.      Power: 250W.      Speed: 2800 r.p.m.</p>		

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			<p>Frequency: 50 Hz. V.Armature: 230V.</p> <p><b>11. DC Motor Speed Controller</b></p> <ul style="list-style-type: none"> <li>- Metallic box.</li> <li>- Regulated voltage output up to 320 Vdc. Maximum current output 2 A.</li> <li>- Front panel including: Connections:</li> <li>- Positive, negative and Ground connections. on/OFF switch.</li> <li>- The top side of the unit include a wheel to adjust the DC output voltage up to 320 Vdc.</li> </ul> <p><b>12. AC Motor Speed Controller</b></p> <ul style="list-style-type: none"> <li>- Metallic box.</li> <li>- Output: 3 PH, 3.0 KVA, 220 V, 1-50 Hz., 8.0 A.</li> <li>- Overload current thermal protection.</li> <li>- on/OFF switch.</li> <li>- It has two blocks in the front panel:</li> <li>- Speed control:</li> <li>- start/stop switch.</li> <li>- speed Control potenciomenter.</li> <li>- Connections to motor:</li> <li>- Three-phase connection to AC motor.</li> <li>- Ground connection.</li> </ul> <p><b>13. Tachogenerator:</b></p> <ul style="list-style-type: none"> <li>- Tachodynamo, 60V, 1000 rpm</li> </ul> <p><b>14. Electronic Brake</b></p> <p>This unit is based in two elements:</p> <p>1. Module -metallic box: Power supply:1 phase, 200-240V. Rated output capacity:0.75 KW. Output frequency range: 0.2 to 400 Hz. Display to visualize voltage (V), Current (A), and Frequency (Hz). Brake resistance included. Torquemeter. R.p.m. Meter. Connectors.</p> <p>2. Braking motor mounted on a bench-support. Connection wire between elements "1" and "2".</p> <p><b>15. Computer Aided Instruction Software System</b> - complementary to the Modules, formed by: Classroom Management Software Package(Instructor Software) only one is required and common for all software packages(student/module/software)</p> <p><b>16. Demonstration Software(Student/Module Software) for a DC Shunt-series compound excitation motor, Single licence</b></p>		
43	1	lot	(Tables, Teacher's and Students' Chairs, Storage Cabinets) 1 Lot	P	P
			Laboratory Table (6units)  2440 x 800mm, 30mm laminated board table top with PVC edging, with two cabinets below (with locks)		
			<p>Powder-coated steel casing for table top electrical outlets with removable front plate, powder-coat finish. Includes wiring provisions for eight 2 gang universal outlet</p> <p>Powder-coated Tubular metal framing with perforated plate cover for table legs support and adjustable metal glides.</p> <p><b>Teacher's table (1)</b> 1000x950x780mm Table 18mm Laminated Board with PVC edging</p>		

